IN THE CLAIMS

Please amend the claims as follows:

Claim 1 (Original): A soft-in-soft-out (SISO) equaliser for use in a receiver of a communications system employing a plurality of transmit antennas, the equaliser comprising:

at least one received signal input for inputting a received signal;

a plurality of likelihood value inputs, one for each transmit antenna, for inputting a plurality of decoded signal likelihood values from a SISO decoder;

a processor configured to determine from said plurality of signal likelihood values an estimated mean and covariance value for a signal from each of said transmit antennas;

an expected signal determiner coupled to said processor to determine an expected received signal value using said mean values;

a subtractor coupled to said received signal input to subtract said expected received signal value from said received signal to provide a compensated signal;

a filter coupled to said subtractor to filter said compensated signal to provide a plurality of estimated transmitted signal values, one for each said transmit antenna;

a filter coefficient determiner coupled to said processor to determine coefficients of said filter using said covariance values; and

an output stage coupled to said filter to output a plurality of transmitted signal likelihood values, one for each said transmit antenna, for input to said SISO decoder.

Claim 2 (Original): A SISO equaliser as claimed in claim 1 further comprising an adjuster to adjust said expected received signal value by an amount dependent upon said estimated mean values.

Claim 3 (Original): A SISO equaliser as claimed in claim 2 further comprising a filter gain controller configured to control the gain of said filter dependent upon said estimated covariance values.

Claim 4 (Original): A SISO equaliser as claimed in claim 1 wherein said filter comprises a linear or transversal filter.

Claim 5 (Original): A SISO equaliser as claimed in claim 1 wherein said filter coefficient determiner is configured to determine said filter coefficients according to a mean square error cost function.

Claim 6 (Original): A SISO equaliser as claimed in claim 1 wherein said filter coefficient determiner is configured to determine said filter coefficients responsive to covariance values of estimated transmitted signal values derived from said signal likelihood values from said SISO decoder.

Claim 7 (Original): A SISO equaliser as claimed in claim 1 configured to utilise substantially constant filter coefficients for equalising a block or packet of received data symbols.

Claim 8 (Original): A SISO equaliser as claimed in claim 7 wherein said filter coefficient determiner is configured to operate in the frequency domain, said equaliser further comprising Fourier transform means prior to said filter and inverse Fourier transform means following said filter.

Claim 9 (Original): A SISO equaliser as claimed in claim 1 for use in a receiver for receiving data from a transmitter configured to transmit data from a plurality of transmit antennas simultaneously, the equaliser comprising a plurality of received signal inputs each coupled to said subtractor for inputting a plurality of received signals one from each of a plurality of receive antennas, and wherein said subtractor is configured to subtract a plurality of expected signal values relating to said plurality of receive antennas from said plurality of received signals to provide compensated signals to said filter.

Claim 10 (Original): A receiver incorporating a soft-in-soft-out (SISO) equaliser for use in a receiver of a communications system employing a plurality of transmit antennas, the equaliser comprising:

at least one received signal input for inputting a received signal;

a plurality of likelihood value inputs, one for each transmit antenna, for inputting a plurality of decoded signal likelihood values from a SISO decoder;

a processor configured to determine from said plurality of signal likelihood values an estimated mean and covariance value for a signal from each of said transmit antennas;

an expected signal determiner coupled to said processor to determine an expected received signal value using said mean values;

a subtractor coupled to said received signal input to subtract said expected received signal value from said received signal to provide a compensated signal;

a filter coupled to said subtractor to filter said compensated signal to provide a plurality of estimated transmitted signal values, one for each said transmit antenna;

a filter coefficient determiner coupled to said processor to determine coefficients of said filter using said covariance values; and

an output stage coupled to said filter to output a plurality of transmitted signal likelihood values, one for each said transmit antenna, for input to said SISO decoder.

Claims 11-15 (Canceled).

Claim 16 (Original): A method of equalising received data in a communications system employing a receiver with at least one receive antenna and a transmitter with a plurality of transmit antennas, the method comprising:

inputting at least one received signal from said at least one receive antenna;

inputting a plurality of decoded signal likelihood values, one for each transmit antenna, from a SISO decoder;

determining from said plurality of signal likelihood values an estimated mean and covariance value for a signal from each of said transmit antennas;

determining an expected received signal value using said mean values;

subtracting said expected received signal value from said received signal to provide a compensated signal;

determining coefficients for a filter using said covariance values;

filtering said compensated signal in accordance with said coefficients to provide a plurality of estimated transmitted signal values, one for each said transmit antenna; and

outputting a plurality of transmitted signal likelihood values, one for each said transmit antenna, derived from said estimated transmitted signal values, for input to said SISO decoder.

Claim 17 (Original): A method as claimed in claim 16 further comprising adjusting said expected received signal value by an amount dependent upon said estimated mean values.

Claim 18 (Original): A method as claimed in claim 17 further comprising controlling the gain of said filter dependent upon said estimated covariance values.

Claim 19 (Original): A method as claimed in claim 16 wherein said filtering comprises linear or transversal filtering.

Claim 20 (Original): A method as claimed in claim 16 wherein said determining substantially minimises a mean square estimated transmitted signal error cost function.

Claim 21 (Original): A method as claimed in claim 16 wherein said determining is responsive to covariance values of estimated transmitted signal values derived from said signal likelihood values from said SISO decoder.

Claim 22 (Original): A method as claimed in claim 16 further comprising maintaining said filter coefficients substantially constant over a block or packet of received data symbols.

Claim 23 (Original): A method as claimed in claim 16 wherein said filtering is performed in the frequency domain.

Claim 24 (Original): A method as claimed in claim 23 further comprising transforming said received signal into the frequency domain prior to said filtering and transforming the result of said filtering into the time domain following said filtering.

Claim 25 (Original): A method as claimed in claim 16 for use in a receiver receiving data from a transmitter configured to transmit data from a plurality of transmit antennas simultaneously, the method comprising inputting a plurality of received signals from a plurality of receive antennas, and wherein said subtracting comprises subtracting a plurality of expected signal values relating to said plurality of receive antennas from said plurality of received signals to provide compensated signals for said filtering.

Claim 26 (Original): A method of turbo equalisation comprising iteratively equalising data by the method comprising:

inputting at least one received signal from said at least one receive antenna;

inputting a plurality of decoded signal likelihood values, one for each transmit antenna, from a SISO decoder;

determining from said plurality of signal likelihood values an estimated mean and covariance value for a signal from each of said transmit antennas;

determining an expected received signal value using said mean values;

subtracting said expected received signal value from said received signal to provide a compensated signal;

determining coefficients for a filter using said covariance values;

filtering said compensated signal in accordance with said coefficients to provide a plurality of estimated transmitted signal values, one for each said transmit antenna;

outputting a plurality of transmitted signal likelihood values, one for each said transmit antenna, derived from said estimated transmitted signal values, for input to said SISO decoder; and

decoding said transmitted signal likelihood values from said equalising to provide decoded signal likelihood values for said equalising.

Claim 27 (Original): A method of turbo-equalising data in a receiver receiving data from a transmitter configured to transmit data from a plurality of transmit antennas simultaneously, the receiver including a SISO decoder, the method comprising:

inputting a received signal vector comprising a block of received signal data including data received from said plurality of transmit antennas;

receiving soft decoded information from said decoder;

processing said received data using a linear filter having a plurality of soft inputs derived from said received signal vector to provide a plurality of soft equaliser outputs, one for each transmit antenna, to said SISO decoder; and

adjusting coefficients of said linear filter in response to said soft decoded information to mitigate MSI and ISI.

Claim 28 (Original): A method of equalising data in a receiver of a communications system with a plurality n_I of transmit antennas the method comprising:

inputting a received signal vector Z_n comprising a block of received signal data at an index n;

inputting from a SISO decoder a set of bit likelihood values $L\left(c^{i}_{n,j}\right)$, $i = 1$ to n_I, j=1 to m where $c^{i}_{n,j}$, denotes a portion of an m-bit codeword symbol at an index n;

determining expectation $E(x_n^i)$ and covariance $\mathrm{cov}(x_n^i, x_n^i)$ values for estimated transmitted signal values x_n^i using the values $\mathrm{L}(c_{n,j}^i)$ where x_n^i denotes an estimated value of a signal transmitted from a transmit antenna i at an index n;

determining an updated estimated transmitted signal value $\hat{x}_n^i$ at index n for each transmit antenna i using $\hat{x}_n^i = K_n^i \mathbf{f}_n^{i\,H}\left[\mathbf{Z}_n - \left(E(\mathbf{Z}_n) - \mathbf{e}^i E(x_n^i)\right)\right]$ where $E(\mathbf{Z}_n) = \mathbf{H}E(X_n)$ and $\mathbf{H}$ is a channel impulse response matrix and $E(\mathbf{X}_n)$ is an expectation value of an estimated transmitted signal vector $\mathbf{X}_n$ at index n derived from values $E(x_n^i)$, where $\mathbf{e}^i$ is the ith column of a matrix $\mathbf{S}$ and $\mathbf{S}=\mathbf{H}\left[\mathbf{0}_{n_I\times(N2+L-1)n_I} \quad \mathbf{I}_{\mathbf{n_I}\times n_I} \quad \mathbf{0}_{n_I\times N1n_I}\right]^H$ where matrix $\mathbf{I}_{i\times i}$ is an $i \times i$ identity matrix and $\mathbf{0}_{i\times j}$ is a matrix in which each element is substantially zero, $\mathbf{f}_n^i$ is the ith column of a filter matrix $\mathbf{F}_n$ and $\mathbf{F}_n$ is derived from $\mathrm{cov}(\mathbf{x}_n, \mathbf{x}_n)$, and where K_n^i is a scalar filter gain; and

outputting equalised likelihood values $\mathrm{L}_e(c_{n,j}^i)$ derived from values $\hat{x}_n^i$.

Claim 29 (Canceled).

Claim 30 (Original): A method as claimed in claim 29 comprising iteratively equalising and decoding to determine values for $\mathrm{L}_e(c_{n,j}^i)$ and $\mathrm{L}(c_{n,j}^i)$ until a termination criterion is reached.

Claim 31 (Original): A method as claimed in claim 30 further comprising deinterleaving said $\mathrm{L}_e(c_{n,j}^i)$ values and interleaving said $\mathrm{L}(c_{n,j}^i)$ values.

Claim 32 (Original): A method as claimed in claim 28 wherein $\mathbf{F}_n$ is derived from $[\mathbf{R}_{WW}+\mathbf{H}\mathbf{R}_{XX}\mathbf{H}^H]^{-1}\mathbf{S}$ where $\mathbf{R}_{XX} = \mathrm{cov}(\mathbf{x}_n, \mathbf{x}_n)$ and $\mathbf{R}_{WW}$ is a noise covariance matrix.

Claim 33 (Original): A method as claimed in claim 28 wherein n indexes time.

Claim 34 (Original): A method as claimed in claim 28 wherein n indexes frequency.

Claim 35 (Original): Processor control code to, when running, implement a method of equalising received data in a communications system employing a receiver with at least one receive antenna and a transmitter with a plurality of transmit antennas, the method comprising:

inputting at least one received signal from said at least one receive antenna;

inputting a plurality of decoded signal likelihood values, one for each transmit antenna, from a SISO decoder;

determining from said plurality of signal likelihood values an estimated mean and covariance value for a signal from each of said transmit antennas;

determining an expected received signal value using said mean values;

subtracting said expected received signal value from said received signal to provide a compensated signal;

determining coefficients for a filter using said covariance values;

filtering said compensated signal in accordance with said coefficients to provide a plurality of estimated transmitted signal values, one for each said transmit antenna; and

outputting a plurality of transmitted signal likelihood values, one for each said transmit antenna, derived from said estimated transmitted signal values, for input to said SISO decoder.

Claim 36 (Original): A carrier carrying the processor control code of claim 35.

Claim 37 (Original): An equaliser configured to operate in accordance with a method of equalising received data in a communications system employing a receiver with at least one receive antenna and a transmitter with a plurality of transmit antennas, the method comprising:

inputting at least one received signal from said at least one receive antenna;

inputting a plurality of decoded signal likelihood values, one for each transmit antenna, from a SISO decoder;

determining from said plurality of signal likelihood values an estimated mean and covariance value for a signal from each of said transmit antennas;

determining an expected received signal value using said mean values;

subtracting said expected received signal value from said received signal to provide a compensated signal;

determining coefficients for a filter using said covariance values;

filtering said compensated signal in accordance with said coefficients to provide a plurality of estimated transmitted signal values, one for each said transmit antenna; and

outputting a plurality of transmitted signal likelihood values, one for each said transmit antenna, derived from said estimated transmitted signal values, for input to said SISO decoder.

Claim 38 (Original): A data communications receiver including an equaliser configured to operate in accordance with a method of equalising received data in a communications system employing a receiver with at least one receive antenna and a transmitter with a plurality of transmit antennas, the method comprising:

inputting at least one received signal from said at least one receive antenna;

inputting a plurality of decoded signal likelihood values, one for each transmit antenna, from a SISO decoder;

determining from said plurality of signal likelihood values an estimated mean and covariance value for a signal from each of said transmit antennas;

determining an expected received signal value using said mean values;

subtracting said expected received signal value from said received signal to provide a compensated signal;

determining coefficients for a filter using said covariance values;

filtering said compensated signal in accordance with said coefficients to provide a plurality of estimated transmitted signal values, one for each said transmit antenna; and

outputting a plurality of transmitted signal likelihood values, one for each said transmit antenna, derived from said estimated transmitted signal values, for input to said SISO decoder.

Claims 39-42 (Canceled).

Claim 43 (Original): Processor control code to, when running, implement a method of equalising data in a receiver of a communications system with a plurality n, of transmit antennas the method comprising:

inputting a received signal vector $\mathbf{Z}_n$ comprising a block of received signal data at an index n;

inputting from a SISO decoder a set of bit likelihood values $L(c_{n,j}^i)$, $i = 1$ to n_I, j=1 to m where $c_{n,j}^i$, denotes a portion of an m-bit codeword symbol at an index n;

determining expectation $E\left(x_n^i\right)$ and covariance $\operatorname{cov}\left(x_n^i, x_n^i\right)$ values for estimated transmitted signal values x_n^i using the values $\mathrm{L}\left(c_{n,j}^i\right)$ where x_n^i denotes an estimated value of a signal transmitted from a transmit antenna i at an index n;

determining an updated estimated transmitted signal value $\hat{x}_n^i$ at index n for each transmit antenna i using $\hat{x}_n^i = K_n^i \mathbf{f}_n^{i^H}\left[\mathbf{Z}_n - \left(E(\mathbf{Z}_n) - \mathbf{e}^i E(x_n^i)\right)\right]$ where $E(\mathbf{Z}_n) = \mathbf{H}E(X_n)$ and $\mathbf{H}$ is a channel impulse response matrix and $E(\mathbf{X}_n)$ is an expectation value of an estimated transmitted signal vector $\mathbf{X}_n$ at index n derived from values $E\left(x_n^i\right)$, where $\mathbf{e}^i$ is the ith column of a matrix $\mathbf{S}$ and $\mathbf{S}=\mathbf{H}\left[\mathbf{0}_{n_I\times(N2+L-1)n_I} \quad \mathbf{I}_{n_I\times n_I} \quad \mathbf{0}_{n_I\times N1 n_I}\right]^H$ where matrix $\mathbf{I}_{i\times i}$ is an $i\times i$ identity matrix and $\mathbf{0}_{i\times j}$ is a matrix in which each element is substantially zero, $\mathbf{f}_n^i$ is the ith column of a filter matrix $\mathbf{F}_n$ and $\mathbf{F}_n$ is derived from $\operatorname{cov}(\mathbf{x}_n, \mathbf{x}_n)$, and where K_n^i is a scalar filter gain; and

outputting equalised likelihood values $\mathrm{L}_e\left(c_{n,j}^i\right)$ derived from values $\hat{x}_n^i$.

Claim 44 (Original): A carrier carrying the processor control code of claim 43.

Claim 45 (Original): An equaliser configured to operate in accordance with a method of equalising data in a receiver of a communications system with a plurality n_I of transmit antennas the method comprising:

inputting a received signal vector Z_n comprising a block of received signal data at an index n;

inputting from a SISO decoder a set of bit likelihood values $\mathrm{L}\left(c_{n,j}^i\right)$, $i = 1$ to n_I, $j = 1$ to m where $c_{n,j}^i$, denotes a portion of an m-bit codeword symbol at an index n;

determining expectation $E\left(x_n^i\right)$ and covariance $\operatorname{cov}\left(x_n^i, x_n^i\right)$ values for estimated transmitted signal values x_n^i using the values $\mathrm{L}\left(c_{n,j}^i\right)$ where x_n^i denotes an estimated value of a signal transmitted from a transmit antenna i at an index n;

determining an updated estimated transmitted signal value $\hat{x}_n^i$ at index n for each transmit antenna i using $\hat{x}_n^i = K_n^i \mathbf{f}_n^{iH}\left[\mathbf{Z}_n - \left(E(\mathbf{Z}_n) - \mathbf{e}^i E(x_n^i)\right)\right]$ where $E(\mathbf{Z}_n) = \mathbf{H}E(X_n)$ and $\mathbf{H}$ is a channel impulse response matrix and $E(\mathbf{X}_n)$ is an expectation value of an estimated transmitted signal vector $\mathbf{X}_n$ at index n derived from values $E\left(x_n^i\right)$, where $\mathbf{e}^i$ is the ith column of a matrix $\mathbf{S}$ and $\mathbf{S}=\mathbf{H}\left[\mathbf{0}_{n_I\times(N2+L-1)n_I} \quad \mathbf{I}_{\mathbf{n_I}\times n_I} \quad \mathbf{0}_{n_I\times N1 n_I}\right]^H$ where matrix $\mathbf{I}_{i\times i}$ is an $i \times i$ identity matrix and $\mathbf{0}_{i\times j}$ is a matrix in which each element is substantially zero, $\mathbf{f}_n^i$ is the ith column of a filter matrix $\mathbf{F}_n$ and $\mathbf{F}_n$ is derived from $\operatorname{cov}(\mathbf{x}_n, \mathbf{x}_n)$, and where K_n^i is a scalar filter gain; and

outputting equalised likelihood values $\mathrm{L}_e\left(c_{n,j}^i\right)$ derived from values $\hat{x}_n^i$.

Claim 46 (Original): A data communications receiver including an equaliser configured to operate in accordance with a method of equalising data in a receiver of a communications system with a plurality n_I of transmit antennas the method comprising:

inputting a received signal vector Z_n comprising a block of received signal data at an index n;

inputting from a SISO decoder a set of bit likelihood values $\mathrm{L}\left(c_{n,j}^i\right)$, $i = 1$ to n_I, $j = 1$ to m where $c_{n,j}^i$, denotes a portion of an m-bit codeword symbol at an index n;

determining expectation $E\left(x_n^i\right)$ and covariance $\operatorname{cov}\left(x_n^i, x_n^i\right)$ values for estimated transmitted signal values x_n^i using the values $\mathrm{L}\left(c_{n,j}^i\right)$ where x_n^i denotes an estimated value of a signal transmitted from a transmit antenna i at an index n;

determining an updated estimated transmitted signal value $\hat{x}_n^i$ at index n for each transmit antenna i using $\hat{x}_n^i = K_n^i \mathbf{f}_n^{i\,H}\left[\mathbf{Z}_n - \left(E(\mathbf{Z}_n) - \mathbf{e}^i E(x_n^i)\right)\right]$ where $E(\mathbf{Z}_n) = \mathbf{H}E(\mathbf{X}_n)$ and $\mathbf{H}$ is a channel impulse response matrix and $E(\mathbf{X}_n)$ is an expectation value of an estimated transmitted signal vector $\mathbf{X}_n$ at index n derived from values $E\left(x_n^i\right)$, where $\mathbf{e}^i$ is the ith column of a matrix $\mathbf{S}$ and $\mathbf{S}=\mathbf{H}\left[\mathbf{0}_{n_I \times (N2+L-1)n_I} \quad \mathbf{I}_{\mathbf{n_I} \times n_I} \quad \mathbf{0}_{n_I \times N1 n_I}\right]^H$ where matrix $\mathbf{I}_{i \times i}$ is an $i \times i$ identity matrix and $\mathbf{0}_{i \times j}$ is a matrix in which each element is substantially zero, $\mathbf{f}_n^i$ is the ith column of a filter matrix $\mathbf{F}_n$ and $\mathbf{F}_n$ is derived from $\mathrm{cov}(\mathbf{x}_n, \mathbf{x}_n)$, and where $\boldsymbol{K}_n^i$ is a scalar filter gain; and

outputting equalised likelihood values $L_e\left(c_{n,j}^i\right)$ derived from values $\hat{x}_n^i$.